AMENDMENTS TO THE SPECIFICATION

On Page 1, after the title of the invention, please insert the following:

RELATED APPLICATION

This application is a continuation of application Serial No. 09/655,833 filed on September 6, 2000.

Please replace the paragraph beginning on page 2, line 7, with the following new paragraph:

In a process using this Cu for interconnections, for example, an interconnection process referred to as the damascene process for burying a metal in a groove-like interconnection pattern formed in an interlayer insulation film in advance, removing excess metal film by a chemical mechanical polishing (CMP) process, and thereby forming the interconnections has become influential. [The] In the damascene process [has the characteristics that], etching of the interconnections becomes unnecessary and [also] a further upper interlayer insulation film becomes flat by itself, so the manufacturing steps can be simplified.

Please replace the paragraph beginning on page 3, line 6, with the following new paragraph:

First, as shown in Fig. 32, for example, an interlayer insulation film 302 made of for example a silicon oxide film is formed [by] for example, by a low pressure chemical vapor deposition (CVD) process on a substrate 301 made of silicon or another semiconductor on which a not illustrated impurity diffusion layer is appropriately formed.

Please replace the paragraph beginning on page 3, line 13, with the following new paragraph:

Next, as shown in Fig. 33, contact holes 303 communicating with the impurity diffusion region of the substrate 301 and grooves 304 in which a predetermined pattern of interconnections to be electrically connected to the impurity diffusion region of the substrate 301 is to be formed are formed by using a well known photolithography technique and etching technique.

Please replace the paragraph beginning on page 3, line 20 and continuing on page 4 with the following new paragraph:

Next, as shown in Fig. 34, a barrier film 305 is formed on the surface of the interlayer insulation film 302 and in the contact holes 303 and the grooves 304. This barrier film 305 is formed by a material such as for example Ta, Ti, TaN, or TiN by the well known sputtering process. The barrier film 305 is provided so as to prevent diffusion of the material comprising the interconnections into the inter-layer insulation film 302. Particularly, in a case where the interconnection material is Cu and the inter-layer insulation film 302 is a silicon oxide film, Cu has a large diffusion coefficient with respect to the silicon oxide film[, so]and is easily oxidized, so this is prevented.

Please replace the paragraph beginning on page 5, line 24, and continuing on page 6 with the following new paragraph:

Recess, or "recessing" is a phenomenon where, as shown in Fig. 40, the interconnection 308 becomes low at the interface between the inter-layer insulation film 302 and the interconnection 308. In this case as well, the sectional area of the interconnections becomes insufficient. This becomes a cause of poor interconnection resistance etc.

Please replace the paragraph beginning on page 12, line 24, and continuing on page 13 with the following new paragraph:

Fig. 5, having Figs. 5 and 5B, is a view of the situation of making the wafer move in an X-axial direction with respect to a polishing tool;

Please replace the paragraph beginning at page 26, line 1, with the following new paragraph:

By employing a configuration in which the insulation plate 22 is made moveable with respect to the main shaft 12a of the holder 12 and in which the insulation plate 22 and the main shaft 12a are connected by the resilient member 25, when feeding high pressure air to the cylinder device 14 and moving the piston rod 14b downward in the direction indicated by the arrow A2, the pressing member 21 pushes the insulation plate 22 downward against a recovery force of the resilient member 25, and the scrub member [25] 24 moves downward together with this. When stopping the feed of the high pressure air to the cylinder device 14, the insulation plate 22 rises due to the recovery force of the resilient member 25 and the scrub member 24 rises together with this.

Please replace the paragraph beginning on page 35, line 3, with the following new paragraph:

As shown in Fig. 7, the scrub member 24 carries current as the anode to the metal film MT formed on the wafer W via the electrolyte EL fed onto the wafer W or by direct contact. Further, the polishing tool 3 carries current as the cathode to the metal film MT formed on the wafer W via the electrolyte EL fed onto the wafer W or by direct contact. Note that, as shown in Fig. 7, there is a gap [ä]δb between the metal film MT and the scrub member 24. Further, as shown in Fig. 8, there is a gap [ä]δw between the metal film MT and the polishing surface 3a of the polishing tool 3.

Please replace the paragraph beginning on page 35, line 14, with the following new paragraph:

As shown in Fig. 7, the insulation plate 4 is interposed between the polishing tool 3 and the scrub member 24 (electrode plate 23), but the resistance R0 of the insulation plate 4 is very large. Accordingly, the current i0 flowing from the scrub member 24 via the insulation plate 4 to the polishing tool 3 is substantially zero. No current flows to the polishing tool 3 from the scrub member 24 via the insulation plate 4.

Please replace the paragraph beginning on page 36, line 9 with the following new paragraph:

Here, the resistance R1 in the electrolyte EL becomes extremely large in proportion to a distance d between the scrub member 24 as the anode and the polishing tool 3 as the cathode. For this reason, by making the inter-electrode

distance d sufficiently larger than the gap[ä]δb and the gap [ä]δw, the current i1 which directly flows through the resistance R1 in the electrolyte EL to the polishing tool 3 becomes very small, the current i2 becomes large, and almost all of the electrolytic current passes through the surface of the metal film MT. For this reason, the electrolytic elution of the copper comprising the metal film MT can be efficiently carried out.

Please replace the paragraph beginning on page 36, line 22, and continuing on page 37 with the following new paragraph:

Further, the magnitude of the current i2 changes according to the size of the gap[ä]δb and the gap [ä]δw, therefore, as mentioned above, by adjusting the size of the gap [ä]δb and the gap [ä]δw by controlling the position of the polishing tool 3 in the Z-axial direction by the controller 55, the current i2 can be made constant. The size of the gap [ä]δw can be adjusted possible by controlling the Z-axis servo motor 18 by using the current value signal 62s as a feedback signal so that the electrolytic current obtained from the current value signal 62s, that is, the current i2, becomes constant.

Please replace the paragraph beginning on page 37, line 8, with the following new paragraph:

Further, the positioning precision of the polishing apparatus 1 in the Z-axial direction is a sufficiently high resolution of 0.1 μm. In addition, the main shaft 12a is inclined with respect to the main surface of the wafer W at a fine angle, so the effective contact area S is always maintained constant, therefore if the value of the electrolytic current is controlled constant, the current density can [be made] always

be made constant and also the amount of electrolytic elution of the metal film can [be made] always be made constant.

Please replace the paragraph beginning on page 38, line 1, with the following new paragraph:

Below, [the] explanation will be made of a polishing method using the electrolytic composite polishing function of the polishing apparatus 1 according to the present embodiment by taking as an example the case where it is applied to a process of formation of an interconnection by the dual damascene process in a semiconductor device of a multilayer interconnection structure.

Please replace the paragraph beginning on page 42 line 1, with the following new paragraph:

The above process is carried out by a process similar to the related art, but in the polishing method of the present invention, the excess metal film 107 and barrier film 105 present on the inter-layer insulation film 102 is removed [by not] not by chemical mechanical polishing, but by electrolytic composite polishing of the polishing apparatus 1.

Please replace the paragraph beginning on page 42, line 22 and continuing on page 43 with the following new paragraph:

Further, as another method, it is also possible to form the passivation film 108 by forming [either] any of for example a water repelling film, an oil film, an antioxidation film, a film made of a surfactant, a film made of a chelating agent, and a film made of a silane coupling agent on the surface of the metal film 107.

Please replace the paragraph beginning on page 45, line 16, with the following new paragraph:

On the other hand, as shown in Fig. 18, near the polishing tool 3, the passivation film 108 present at the metal film [108] 107 is removed from the higher portions by the mechanical removal action of the polishing tool 3 or the mechanical removal action of the polishing abrasive PT.

Please replace the paragraph beginning on page 48, line 16, with the following new paragraph:

The surface area of the copper comprising the metal film 107 becomes maximum at the point of time when the passivation film 108 is completely removed. Simultaneously with this, the current monitored by the ammeter 62 rises from the position of P1 in Fig. 25, rises along with the removal of the passivation film 108, and then [gets] becomes maximum at the point of time indicated by P2 where the surface area of the copper becomes the maximum. The processes up to here complete the flattening of the initial unevenness of the surface of the metal film 107.

Please replace the paragraph beginning on page 49, line 2, with the following new paragraph:

In this way, the electrolytic composite polishing of the present embodiment is polishing in which the polishing rate is electrically and chemically assisted, therefore the polishing can be carried out by a low polishing pressure in comparison with the usual chemical mechanical polishing. This is very advantageous in view of the reduction of the scratches, performance in easing step differences, and the reduction of dishing and erosion even in comparison [as] with simple mechanical polishing.

Please replace the paragraph beginning on page 50, line 4, with the following new paragraph:

When the barrier film 105 is exposed, when use is made of a material such as Ta, Ti, TaN, or TiN, the electrical resistance is larger in comparison with copper, therefore the current value monitored by the ammeter 62 starts to be lowered from the point of time indicated by P3 when the exposure of the barrier film 105 in Fig. 25 is commenced. In this state, a nonuniform amount of copper film of the metal film 107 remains. The polishing is [once] then stopped in this state.

Please replace the paragraph beginning on page 50, line 19, with the following new paragraph:

In the process for removing this barrier film 105, [not] a slurry SL having a high polishing rate with respect to the metal film 107 made of copper described above is not used, but a slurry SL having a high polishing rate with respect to the barrier film 105 formed by a material such as Ta, TaN, Ti, or TiN, and having a low polishing rate with respect to the metal film 107 is used. Namely, use is made of a slurry SL having a selectivity of the polishing rate of the barrier film 105 and the metal film 107 as large as possible.

Please replace the paragraph beginning on page 51, line 4, with the following new paragraph:

Further, from the viewpoint of suppressing the occurrence of dishing and erosion due to [over polishing] over-polishing etc., the output voltage of the electrolytic power supply 61 is made smaller than that in the above process and then the polishing and removal of the barrier film 105 are carried out. Further, preferably also the polishing pressure of the polishing tool 3 is made smaller than that in the above process.

Please replace the paragraph beginning on page 53, line 3, with the following new paragraph:

Further, if the selectivity is set low, dishing can be reduced to a certain extent, but the dimensional precision depends upon the uniformity of distribution of the amount of removal in the wafer plane. Therefore there also occurs a case where the removal of the barrier film 105 and the metal film 107 is not sufficient. For this reason, in order to prevent the state where the barrier film 105 and the metal film 107 remain at the top surface of the inter-layer insulation film 102, that is, [under polish, over polish] under-polish, over-polish of the amount of the nonuniformity of the amount of removal in the plane becomes necessary, and degradation of erosion due to this [over polish] over-polish cannot be essentially avoided.

Please replace the paragraph beginning on page 54, line 2, with the following new paragraph:

As described above, a barrier film 105 formed by a material such as Ta, TaN, Ti, or TiN can be completely removed and, at the same time, occurrence of dishing and erosion due to [over polish] over-polish can be suppressed.

Please replace the paragraph beginning on page 54, line 6, with the following new paragraph:

Further, in the removal process of the barrier film 105 mentioned above, by setting an absolute current value low and a mechanical load light, the removal speed becomes slower, but if the metal film 107 made of the copper film of the remaining amount of the portion where the remaining film thickness is nonuniform is small, since the barrier film 105 is thin in comparison with the metal film 107, the amount of removal per se of the barrier film 105 is small, therefore even if there is variation and

nonuniformity in this process, the absolute value of the dishing and erosion can be made [to a] negligible [small extent] and the processing time can be shortened.

Please replace the paragraph beginning at page 54, line 19, with the following new paragraph:

Further, since the polishing method according to the present embodiment is composite polishing of mechanical polishing plus an electrochemical action, the flattened surface suffers from little damage and thus a smooth surface [smooth] can be obtained mechanically.

Please replace the paragraph beginning at page 58, line 8, with the following new paragraph:

Further, according to the method for producing a semiconductor device according to the present embodiment, at the point of time when the excess metal film 107 is removed and the barrier film 105 is exposed, the polishing is stopped, the slurry SL is changed to a material having a high polishing rate with respect to the barrier film 105, and the polishing conditions such as the output voltage of the electrolytic power supply 61 are changed to remove the excess barrier film 105, therefore the excess barrier film 105 can be reliably removed. Even in the case where [over polish] over-polish is necessary, the amount of dishing and erosion can be kept small.

Please replace the paragraph beginning at page 58, line 20, with the following new paragraph:

Further, according to the method for producing a semiconductor device according to the present embodiment, the metal film is highly efficiently polished by the electrolytic composite polishing, therefore the polishing pressure of the polishing tool 3 can be made low, so even in a case where for example use is made of an organic low dielectric constant film or a porous low dielectric constant insulation film

having a relatively low mechanical strength as the inter-layer insulation film 102 in order to reduce the dielectric constant from the [viewpoints] viewpoint of lowering the power consumption and [the] increasing the speed, the damage to these insulation films can be reduced.

Please replace the paragraph beginning at page 65, line 8, with the following new paragraph:

Summarizing the effects of the present invention, according to the present invention, since the metal film is polished by the composite actions of mechanical polishing and electrolytic polishing, in comparison with the case of the flattening of the metal film by mechanical polishing, a very highly efficient selective removal and flattening of the projecting portions of the metal film [become] becomes possible.

Please replace the paragraph beginning at page 67, line 8, with the following new paragraph:

While the invention has been described with reference to specific [embodiment] embodiments chosen for purpose of illustration, it should be apparent that numerous modifications could be made thereto by those skilled in the art without departing from the basic concept and scope of the invention.